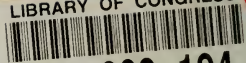


T 171
C 3323

1889

LIBRARY OF CONGRESS



0 030 003 124 9

CASE SCHOOL OF APPLIED SCIENCE, {
CLEVELAND, O., July, 1889. }

The edition of the Catalogue for last school year is exhausted. This circular has been prepared to send to those desiring information concerning the school, until the new edition of the Catalogue is issued. Those desiring any special information not contained in this circular, may address

CADY STALEY, President.

1
23
1



days

Case School of Applied Science

General Information.

Leonard Case, the founder of the Case School of Applied Science, on the 24th of February, 1876, executed a trust deed, setting apart certain lands to endow and establish a scientific school in the city of Cleveland. In the trust deed he directed the trustee—

“To cause to be formed and regularly incorporated under the laws of Ohio, an institution of learning to be called the ‘Case School of Applied Science,’ and located in said City of Cleveland, in which shall be taught, by competent professors and teachers, Mathematics, Physics, Engineering—Mechanical and Civil,—Chemistry, Economic Geology, Mining and Metallurgy, Natural History, Drawing, and Modern Languages. * * * And, without intending to make it a condition or limitation of this conveyance, or any binding restriction upon the power of such Trustees, the said grantor does hereby recommend to them to hold said property without alienation, and apply the rents, issues and profits thereof to the uses and purposes above, and that the expenditures for such institution be not permitted to exceed the annual income derived from said property.”

After the death of Mr. Case, January 6, 1880, the necessary steps were taken to secure legal incorporation. The original incorporators were as follows:

- | | |
|-------------------------------|--------------|
| HENRY G. ABBEY, | Cleveland. |
| ALVA BRADLEY, | Cleveland. |
| JAMES D. CLEVELAND, | Cleveland. |
| J. H. DEVEREUX, | Cleveland. |
| E. B. HALE, | Cleveland. |
| T. P. HANDY, | Cleveland. |
| REUBEN HITCHCOCK, | Painesville. |
| LEVI KERR, | Cleveland. |
| H. B. PAYNE, | Cleveland. |
| JOSEPH PERKINS, | Cleveland. |
| RUFUS P. RANNEY, | Cleveland. |
| W. S. STREATOR, | Cleveland. |
| JAMES J. TRACY, | Cleveland. |
| J. H. WADE, | Cleveland. |
| SAMUEL WILLIAMSON, | Cleveland. |

T 171
C 3323

In 1881 instruction was undertaken, on a limited scale, in the residence of the late Mr. Case, on Rockwell street, and continued there until June, 1885. In September, 1885, the School was transferred to the ample accommodations in the new building on Euclid avenue.

The city of Cleveland affords unusual advantages for a scientific school. It is an important railroad center and lake port, and offers excellent opportunities for studying the various engineering problems connected with transportation. It is the center of extensive mining and manufacturing interests. It has chemical works, steel works, rolling mills, furnaces, forges, machine shops, and manufactories of electric machines and appliances, and of various other sorts. These, in many cases, are the most extensive of their kind in this country, and their variety is noteworthy. Almost all varieties of engineering structures and of manufacturing processes can be seen in the city, and are available for examination and study by the students.

The Kerr Professorship of Mathematics.

To the late Mr. Levi Kerr, one of the incorporators and a Trustee, the School is largely indebted for cordial support and co-operation, both as an officer and as the representative of the estate of its founder, from its inception and organization.

His influence over the School will be perpetuated in its growth and usefulness in the future, through the generosity of his sister, Mrs. Laura K. Axtell, by the munificent endowment of the Kerr Professorship of Mathematics.

Library Facilities.

Through the liberality of the Directors of the Case Library, the students of the Case School have free access to the books and periodicals of that library.

Fees and Expenses.

The fee for tuition is seventy-five dollars a year, and the fee for chemicals and use of instruments and apparatus is twenty-five dollars a year. One-half of these fees is payable on the first day of the school year, and one-half at the beginning of the second term. No deduction is made for absence during term time.

In Exchange.

Wes Res Hist Soc

OCT 4 1909

Each student is required, upon entrance, to deposit twenty dollars as security against possible injury to the building or furniture, and for breakage of apparatus in the laboratories. This deposit is retained until the student severs his connection with the School, and it will be increased whenever the damage to school property or laboratory breakage exceeds the amount of the first deposit. When the student leaves the School, the balance of the deposit is returned to him.

There are no fees for registration or for graduation, and no extras of any kind. The above are all the fees paid to the School, and they will thus be found quite as reasonable as the apparently lower rates where "incidentals" and "extras" are variable in amount and indefinite as to expense.

The cost of text-books, stationery, etc., will average about twenty-five dollars a year. Board and rooms can be obtained at from four to six dollars per week. The total expense for the school year of the above named items may vary from \$275 to \$350.

Scholarships.

The Trustees have established twelve free scholarships, to be awarded, three annually, to students of the Cleveland High Schools. These scholarships are to be assigned to those who have taken the highest standing in the preparatory course of study for Case School of Applied Science.

The Superintendent of Instruction and the Principals of the High Schools of Cleveland constitute the committee for awarding the scholarships, all awards to be subject to the approval of the President of Case School.

In order that any student may continue to receive the benefit of a scholarship, he must maintain the high standing for which it was originally awarded.

Examinations.

At the close of the first term, an examination is held upon the studies of this term. The annual examination includes the studies of the second term, and, at the discretion of the instructor, it may cover, in any subject, the work of the entire

year. Students conditioned at either of these examinations must remove the condition by another examination at the beginning of the next school year, or they will be required to repeat the subject in full. But a student conditioned at a semi-annual examination may, if he chooses, take another examination at the close of the second term. Whenever a condition is received on laboratory work, the full course must be repeated. If the yearly average of any student falls below the minimum requirements in four subjects, he will be required to repeat the entire work of that year.

Degrees.

The degree of Bachelor of Science (B. S.) will be given to those who complete, in a satisfactory manner, either of the regular courses of study. Previous to the conferring of the degree, the candidate must prepare and hand in a satisfactory thesis upon some technical subject, selected by him, with the approval of the professor in charge of the department in which he desires to graduate.

The engineering degrees—viz. : Civil Engineer, Mechanical Engineer, Electrical Engineer, and Engineer of Mines—will be conferred upon graduates in those departments who pursue their technical studies one year more, or have been engaged in professional work in positions of responsibility for three years; in either case, a further thesis on an entirely original technical topic, or a detailed account or report of the professional work engaged upon, must be presented for acceptance at least twenty days prior to the date of conferring degrees.

Terms and Vacations.

The regular courses of study are completed in four years. Each year is divided into two terms. The school year begins about the last of September and ends about the middle of June. There is a short vacation at the Christmas holidays.

Discipline.

Students are required to be regular in their attendance at lectures, recitations, drawing room and laboratory exercises, to be quiet and orderly while in the building, and in their general conduct to conform to the regulations of the School.

Requirements for Admission.

Candidates for admission to the first class of the regular courses of study must be at least sixteen years of age, and they must be prepared to pass an examination in English Grammar and Composition, Arithmetic, including the Metric System of Weights and Measures, Algebra, Geometry, and the elements of Physics and Chemistry.

In 1889 the examinations for admission will be held on June 12 and 13, and September 23 and 24, beginning at 9 o'clock, and the requirements will be as follows:

ARITHMETIC.—Examples in all the fundamental rules, together with reductions in the Metric System of Weights and Measures.

ALGEBRA.—Fundamental principles and operations, Factoring, Least Common Multiple, Greatest Common Divisor, Fractions, Involution, Evolution, Radicals of the second degree, Simple and Simultaneous Equations of the first and second degree.

GEOMETRY.—Plane and Solid.

ENGLISH.—The principles of English Grammar and Composition.

CHEMISTRY.—Eliot and Storer's Elementary Manual of Chemistry, or an equivalent.

PHYSICS.—Stewart's Elementary Physics, or an equivalent.

Candidates for any other class than the first are also examined in all studies previously pursued by the class they desire to enter.

Students from other Scientific Schools or Colleges, in addition to passing a satisfactory examination, will be required to present a letter of honorable dismissal.

Courses of Instruction.

The Case School of Applied Science provides courses of instruction in Civil Engineering, Mechanical Engineering, Electrical Engineering, Mining Engineering, Drawing, Physics, Chemistry, Mineralogy, Geology, Mathematics, Astronomy, and the English, French and German languages. These courses of study are intended to give a thorough training in the principles of physical science, and to offer a practical education as a preparation for scientific pursuits.

The following regular courses of study have been established ; each course requires four years for completion, and for proficiency in any of them the degree of Bachelor of Science in the course pursued is conferred :

- I. GENERAL COURSE.
- II. CIVIL ENGINEERING.
- III. MECHANICAL ENGINEERING.
- IV. MINING ENGINEERING.
- V. ELECTRICAL ENGINEERING.
- VI. PHYSICS.
- VII. CHEMISTRY.

The General Course is intended for students who do not desire to give as much time to a single topic as is given in the other regular courses. During the last two years the course is largely elective. The choice of any study is subject to the approval of the President and of the Professor in whose department the student desires to work.

In the synopsis of studies, given on the following pages, it will be seen that during the first year the work is the same for all regular students in the School. At the end of this year the student is expected, with the advice of the instructors, to select one of the regular courses of study to be pursued during the remaining three years of his course. His work for the second year begins with preparatory studies relating to the special subject he has selected, and toward the close of the course his attention is given exclusively to his special subject.

Special Students.

Persons who desire to pursue special branches, and who are not candidates for a degree, will be permitted to enter the School as special students, without passing the regular examination. They must be prepared to pursue profitably the work which they select, and must conform to the regulations of the School with regard to recitations and term examinations. If desired, a certificate of proficiency in the subject pursued will be given to those who have studied in any department at least one year.

Arrangements are made in the laboratories for those who desire to fit themselves in special branches, either for teaching or for practical work.

Regular Courses of Study.

I.

GENERAL COURSE.

FIRST YEAR.

FIRST TERM.

Algebra and Trigonometry.
Chemistry (Lectures).
Chemical Laboratory.
Rhetoric.
French.
Mechanical Drawing.

SECOND TERM.

Analytical Geometry.
Chemistry (Lectures).
Chemical Laboratory.
English Literature.
French.
Descriptive Geometry and Drawing.

SECOND YEAR.

FIRST TERM.

Surveying.
Analytical Geometry.
Descriptive Geometry.
Physics (Lectures and Recitations.)
German.
French.
Drawing.

SECOND TERM.

Surveying and Leveling.
Calculus.
Shades and Shadows.
Physics (Lectures and Recitations.)
German.
French.

THIRD YEAR.

FIRST TERM.

Mechanics.
Logic.
German.
Elective. { Physics.
Chemistry.
Engineering.
Mathematics.

SECOND TERM.

German.
Geology.
Elective. { Physics.
Chemistry.
Engineering.
Mathematics.

FOURTH YEAR.

FIRST TERM.

Astronomy.
Elective. { Physics.
Chemistry.
Engineering.
Mathematics.

SECOND TERM.

Elective. { Physics.
Chemistry.
Engineering.
Mathematics.

II.

COURSE IN CIVIL ENGINEERING.

FIRST YEAR.

FIRST TERM.

Algebra and Trigonometry.
Chemistry (Lectures).
Chemical Laboratory.
Rhetoric.
French.
Mechanical Drawing.

SECOND TERM.

Analytical Geometry.
Chemistry (Lectures).
Chemical Laboratory.
English Literature.
French.
Descriptive Geometry and Drawing.

SECOND YEAR.

FIRST TERM.

Surveying.
Analytical Geometry.
Descriptive Geometry.
Physics (Lectures and Recitations).
German.
French.
Drawing.

SECOND TERM.

Surveying and Leveling.
Calculus.
Shades, Shadows and Perspective.
Physics (Lectures and Recitations).
French.
German.
Drawing.

THIRD YEAR.

FIRST TERM.

Railroad Engineering.
Strength of Materials.
Mechanics.
Physics (Lectures and Laboratory).
Topography.
German.
Mineralogy.
Drawing.

SECOND TERM.

Railroad Engineering.
Mechanics.
Machine Drawing.
Stability of Structures.
Physics (Lectures and Laboratory).
Stereotomy.
German.
Geology.

FOURTH YEAR.

FIRST TERM.

Astronomy.
Graphical Statics.
Steam Engine.
Hydraulic Engineering.
Roofs and Bridges.
Architecture.

SECOND TERM.

Engineering Construction.
Details of Practice and Design.
Specifications and Contracts.
Sanitary Engineering.
Geodesy.
Thesis Work.

III.

COURSE IN MECHANICAL ENGINEERING.

FIRST YEAR.

FIRST TERM.

Algebra and Trigonometry.
Chemistry (Lectures).
Chemical Laboratory.
Rhetoric.
French.
Mechanical Drawing.

SECOND TERM.

Analytical Geometry.
Chemistry (Lectures).
Chemical Laboratory.
English Literature.
French.
Descriptive Geometry and Drawing.

SECOND YEAR.

FIRST TERM.

Mechanism.
Machine Drawing.
Shop Work.
Surveying.
Analytical Geometry.
Physics (Lectures and Recitations).
German.
French.

SECOND TERM.

Mechanism.
Machine Drawing.
Shop Work.
Calculus.
Physics (Lectures and Recitations).
German.
French.

THIRD YEAR.

FIRST TERM.

Steam Engineering.
Machine Drawing.
Shop Work.
Calculus.
Mechanics.
Physics (Lectures and Laboratory).
German.

SECOND TERM.

Steam Engineering.
Machine Design.
Shop Work.
Mechanics.
Physics (Lectures and Laboratory).
German.
Slide Valve, Link Motion, Governors.
Mechanical Engineering Laboratory.

FOURTH YEAR.

FIRST TERM.

Mechanical Engineering.
Machine Design.
Shop Work.
Mechanical Engineering Laboratory.

SECOND TERM.

Mechanical Engineering.
Machine Design.
Thesis Work.
Shop Work.
Mechanical Engineering Laboratory.

IV.

COURSE IN ELECTRICAL ENGINEERING.

FIRST YEAR.

FIRST TERM.

Algebra and Trigonometry.
Chemistry (Lectures).
Chemical Laboratory.
Rhetoric.
French.
Mechanical Drawing.

SECOND TERM.

Analytical Geometry.
Chemistry (Lectures).
Chemical Laboratory.
English Literature.
French.
Descriptive Geometry and Drawing.

SECOND YEAR.

FIRST TERM.

Surveying.
Analytical Geometry.
Descriptive Geometry with Drawing.
Physics (Lectures and Recitations).
French.
German.
Mechanism.
Physical Laboratory.
Drawing.

SECOND TERM.

Surveying and Leveling.
Calculus.
Shades and Shadows.
Physics (Lectures and Recitations).
French.
German.
Mechanism.
Machine Drawing.
Physical Laboratory.

THIRD YEAR.

FIRST TERM.

Strength of Materials.
Mechanics.
Physics (Lectures and Laboratory).
Mineralogy.
German.
Steam Engineering.
Design.
Shop Work.

SECOND TERM.

Mechanics.
Machine Drawing.
Materials of Engineering.
Physics (Lectures and Laboratory).
German.
Steam Engineering.
Design.
Shop Work.

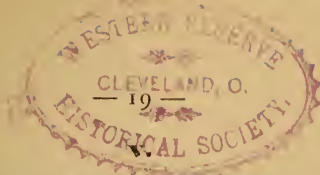
FOURTH YEAR.

FIRST TERM.

Thermodynamics.
Engineering Construction.
Graphical Statics.
Details of Practice and Design.
Electrotechnics.
Physical Laboratory (Electrical Testing.)

SECOND TERM.

Advanced Course in Electricity.
Engineering Construction.
Specifications and Contracts.
Thesis Work.



COURSE IN MINING ENGINEERING.

FIRST YEAR.

FIRST TERM.

Algebra and Trigonometry.
Chemistry (Lectures).
Chemical Laboratory.
Rhetoric.
French.
Mechanical Drawing.

SECOND TERM.

Analytical Geometry.
Chemistry (Lectures).
Chemical Laboratory.
English Literature.
French.
Descriptive Geometry and Drawing.

SECOND YEAR.

FIRST TERM.

Chemical Analysis.
Surveying.
Calculus.
Physics (Lectures and Recitations).
Mechanism.
French.
German.
Chemical Philosophy.

SECOND TERM.

Calculus.
Chemical Analysis.
Surveying and Leveling.
Physics (Lectures and Recitations).
Mechanism.
French.
German.

THIRD YEAR.

FIRST TERM.

Chemical Analysis.
Mining Engineering.
Mechanics.
Physics (Lectures and Laboratory).
Mineralogy.
German.
Steam Engine.
Topography.

SECOND TERM.

Chemical Analysis.
Mining Engineering.
Mechanics.
Machine Drawing.
Materials of Engineering.
Physics (Lectures and Laboratory).
German.
Geology.
Assaying.

FOURTH YEAR.

FIRST TERM.

Chemical Analysis.
Engineering Construction.
Metallurgy (Lectures).
Metallurgy (Practical Work).
Ore Treatment.

SECOND TERM.

Chemical Analysis
Engineering Construction.
Metallurgy (Lectures).
Metallurgy (Practical Work).
Thesis Work.

VI.
COURSE IN PHYSICS.

FIRST YEAR.

FIRST TERM.

Algebra and Trigonometry.
Chemistry (Lectures).
Chemical Laboratory.
Rhetoric.
French.
Mechanical Drawing.

SECOND TERM.

Analytical Geometry.
Chemistry (Lectures).
Chemical Laboratory.
English Literature.
French.
Descriptive Geometry and Drawing.

SECOND YEAR.

FIRST TERM.

Physics: Lectures and Recitations
in Analytical Mechanics.
Physical Laboratory.
Calculus.
Descriptive Geometry.
Chemical Philosophy.
Chemical Laboratory.
French.
German.

SECOND TERM.

Physics: Lectures and Recitations
in Heat.
Physical Laboratory.
Calculus.
Chemical Laboratory.
French.
German.

THIRD YEAR.

FIRST TERM.

Physics: Lectures and Recitations
in Sound and Electricity.
Physical Laboratory.
Analytical Mechanics.
German.

SECOND TERM.

Physics: Lectures and Recitations
in Optics.
Physical Laboratory.
Analytical Mechanics.
German.

FOURTH YEAR.

FIRST TERM.

Physics: Lectures and Recitations
in Thermodynamics.
Course of Reading in Higher Optics.
Physical Laboratory (Research).
Practical Astronomy.
Strength of Materials.
Graphical Statics.

SECOND TERM.

Physical Laboratory (Research).
Mathematical Astronomy.
Graphical Statics.
Advanced Course of Reading in
Electricity.

VII.
COURSE IN CHEMISTRY.

FIRST YEAR.

FIRST TERM.

Algebra and Trigonometry.
Chemistry (Lectures).
Chemical Laboratory.
Rhetoric.
French.
Mechanical Drawing.

SECOND TERM.

Analytical Geometry.
Chemistry (Lectures).
Chemical Laboratory.
English Literature.
French.
Descriptive Geometry and Drawing.

SECOND YEAR.

FIRST TERM.

Chemical Philosophy.
Qualitative Analysis.
Calculus.
Physics (Lectures).
Mineralogy.
German.
French.

SECOND TERM.

Quantitative Analysis.
Physics (Lectures).
German.
French.
Calculus.

THIRD YEAR.

FIRST TERM.

Chemical Analysis.
Organic Chemistry (Lectures).
Organic Chemistry (Laboratory).
Physics (Lectures).
Physical Laboratory.
German.

SECOND TERM.

Chemical Analysis.
Organic Chemistry (Lectures).
Organic Chemistry (Laboratory).
Physics (Lectures).
Physical Laboratory.
German.

FOURTH YEAR.

FIRST TERM.

Chemical Technology.
Gas Analysis.
Metallurgy.
Assaying.

SECOND TERM.

Industrial Chemistry (Laboratory).
Special Study in Preparation of
Thesis.

Methods of Instruction.

The methods of instruction include lectures, recitations, laboratory practice, and field work. While a thorough theoretical knowledge of each subject is required, great importance is attached to practical training, as a source of mental discipline, as well as a preparation for active pursuits. Practical work is, therefore, made an important feature in the courses of study, and each student is expected to spend a large portion of his time in the laboratories and drawing rooms, or in the field.

English.

All students will receive instruction during the first year in Rhetoric, including English Composition, and in English Literature. In Rhetoric, special attention will be paid to diction, construction of sentences, figures of rhetoric, and proprieties of style. In English Literature, the lives of noted authors will be studied, together with selections from their most popular writings.

Modern Languages.

In French, during the first year, three hours a week will be devoted to pronunciation, reading, and the construction of the language.

The study of German extends throughout the second and third years. The first year will be devoted to acquiring the principles of the language; the second year to translations from scientific German. At the end of the third year, the student is expected to have acquired a sufficient knowledge of the languages to be able to use French and German scientific works.

Mathematics.

It is attempted to give *every* student a thorough working knowledge of Algebra, Trigonometry, and Analytical Geometry, and an elementary knowledge of Differential and Integral Calculus. Students who pursue courses in Physics, Astronomy, or Engineering, will, in addition, take a more complete course in the Calculus, and will study Differential Equations and Analytical Mechanics. Those selecting Mathematics will be directed and assisted in a more extended course of reading.

Five hours a week will be devoted to Mathematics during the first three years by all students except those of Chemistry, who will only be required to complete the elementary course in Calculus.

Drawing.

Instruction in Mechanical Drawing is begun at the beginning of the first year, with a series of introductory lectures on the use of drawing instruments and materials.

Descriptive Geometry is begun about the middle of December, and continued to the close of the second year. This course includes orthographic projection, spherical projections, shades, shadows, and perspective.

The graphical work in shades and shadows is also accompanied by exercises in tinting and shading with water colors.

In perspective, after the student has become familiar with the principles, he is required to execute a finished perspective drawing of some architectural or engineering design.

In the third year, instruction is given in Stereotomy and in Topographical Mapping. The class will take the field under the charge of the instructor, and make a complete topographical survey, which will embody all the methods of work given to the class.

The map of the survey will be plotted from the notes and sketches taken, in accordance with the most approved methods in use on the topographical works of the U. S. Corps of Engineers, supplemented by additional lectures and exercises on topographical conventionalizing in ink and colors, and in lettering.

The Civil Engineering students continue drawing in connection with all their technical studies.

Civil Engineering.

The instruction in this department is intended to give the student such familiarity with the use and adjustment of surveyors' and engineers' instruments, and such a knowledge of the theory and practice of Civil Engineering, as will render him immediately useful in the field and office, and will enable him to advance into positions of responsibility.

The instruction is made as practicable as possible, and field work is made a prominent feature of the course.

The course includes the following subjects :

SURVEYING.—Land Surveying with chain, compass and transit ; Leveling, direct, trigonometric and barometric ; Topographical Surveying ; Geodetic Surveying ; Mining Surveying ; Hydrographical Surveying.

MECHANICS OF ENGINEERING.—Statical forces, weights of bodies, fluid pressure, etc. Dynamical forces, bodies in motion, impact, etc.

Resistance of materials to extension, compression, torsion, bending and breaking.

Stability of structures, roofs, bridges, retaining walls, etc.

ENGINEERING CONSTRUCTION.—Materials, foundations, masonry, carpentry, iron work, etc.

ROAD ENGINEERING.—Reconnaissance, location and construction of Roads, Pavements, Railroads.

BRIDGE ENGINEERING.—Designs for bridges in wood, iron and stone.

HYDRAULIC ENGINEERING.—Water Supply, canals, irrigation, river and sea-coast improvements, etc.

SANITARY ENGINEERING.—Drainage, sewerage, ventilation, etc.

Engineering Specifications, Contracts and Estimates will be taken up in connection with the studies of details in practice and design, as practiced in an engineer's office for actual constructions. The student, while engaged upon the above studies, will make frequent visits, under the direction of the instructor, to the various engineering works, quarries and industrial manufactories of practical interest to the engineer. The students are required to present detailed reports, prepared from the notes and sketches taken while engaged on these class excursions.

Mechanical Engineering.

The instruction in this department is intended to give a thorough theoretical knowledge of such work as the student will be likely to have in practice after leaving the School. In addition to this, the work is made as practicable as possible.

The instruction is given by means of lectures, recitations, drawing and design, laboratory and shop work. The laboratory work is intended to be a prominent feature of the course, giving the student an opportunity for testing the tensile, compressive, and transverse strength of materials; the economical use of steam in steam engines and boilers, etc.

Frequent visits are made to the most important manufacturing establishments in the vicinity, enabling the student to become familiar with the processes of manufacture and the arrangement of machinery and shafting, as well as with the mechanism of the machinery itself. The students are required to take full notes and make sketches during these excursions.

Among the establishments visited last year were the works of the Prospect Machine and Engine Co.; Brown Hoisting and Conveying Co.; Warner & Swasey; Cleveland Forge Co.; C. C. C. & I. Locomotive Repair Shops, etc.

The work by years is as follows:

SECOND YEAR.—Elements of mechanism, construction of gear teeth, mechanism of shop and mill machinery, processes of manufacture, and arrangement of machinery in shop.

THIRD YEAR.—Thermodynamics, including the theory of heat engines generally, injectors, condensers, and flow of steam through orifices.

Steam boilers, their mechanism, materials of construction, wear and tear, mountings, combustion of coal, evaporative power, etc.

Steam engine, valve motions, governors, fly-wheels, indicators and indicator diagrams, etc.

FOURTH YEAR.—Hydromechanics, hydraulic machinery, water wheels and turbines, their construction and efficiency.

Applied mechanics, including strength of materials, stability of arches, etc., and friction.

Tall chimney construction.

Mill engineering, including mill construction, and equipment of mills and shops.

DRAWING AND DESIGN.—In the second year the students make complete working drawings from sketches and dimensions that they themselves have taken directly from machinery.

Tracings are made of all drawings, and copied by the “blue process.” During the third and fourth years, the students will design several machines, including a lathe, boiler, steam engine, etc.

LABORATORY WORK.—The laboratory work in this department is intended to give to the students practice in such experimental work as they are liable to undertake after leaving the School, and to instill into their minds correct methods of research and original investigation. The work to be done consists of: tests of the strength of materials, evaporative power and efficiency of boilers, steam engine tests, showing their economy in the use of steam under various loads, cut-offs, speeds, etc. ; calorimeter and condenser tests, etc.

SHOP WORK.—Enough shop work is required of the students to enable them to become familiar with the more common tools used in modern work. The shops are supplied with all tools and machinery needed to accommodate the students. The second year work consists of pattern making, in which the students not only become familiar with the tools and appliances used in the work, but are expected to understand how all ordinary patterns should be made so as to be most easily moulded. The third year work consists of blacksmithing, chipping and filing, and the fourth year of work in the machine shop, with lathe, shaper, drill, etc.

Electrical Engineering.

In view of the important advances in the application of Electricity and Magnetism to electric lighting, electro-metallurgy, and electric transmission of power, a course will be given in Electrical Engineering,

The first three years of the course are intended to cover very nearly the same ground as the course in Mechanical Engineering, while during the fourth year the particular attention is devoted to Electricity and Magnetism, both theoretical and practical. Examples of practical problems assigned are: management of

batteries, measurements of currents, resistances and electromotive forces, constants of galvanometers, electrometers and dynamometers; location of faults in telegraphic circuits; laws of electro-magnets; intensity of magnetic fields; efficiency of storage batteries, electric lights, and dynamo machines.

During the latter half of the fourth year, the student is expected to undertake some original research connected with Electricity or Magnetism, which is to form the subject of a thesis.

Mining Engineering.

The course in Mining Engineering comprises the studies common to all of the engineering courses, and, in addition, special instruction in Mining Surveying, Mining Machinery, Chemistry, Mineralogy, Geology, and Metallurgy.

METALLURGY.—The instruction in Metallurgy consists of a course of lectures and recitations twice a week, extending throughout the year. The work of the first term includes lectures on fuels, refractory materials, iron, steel and copper, and of the second on gold, silver, lead, zinc, aluminum and mercury. Visits are made to the blast furnaces and various metal-working establishments of the city, for the purpose of acquiring practical knowledge of and familiarity with the methods in present use. Students in the Mining Engineering course are required to prepare memoirs on subjects assigned to them, with special reference to economic construction of metallurgical plants, and the dressing and working of various ores. They are also expected to spend a considerable part of the third and fourth years in the laboratory, to follow out practical problems in ore working, and the more important wet and dry methods of metal extraction. For this purpose, ores of gold, silver, lead, copper, etc., are obtained from various localities, sampled and assayed by the student, and the most economic and practical method of working decided upon and followed out.

MINERALOGY.—In connection with the department of Chemistry, a course of lectures is given on crystallography, blow-pipe analysis, and determinative mineralogy. The laboratory work includes a study of crystalline forms by means of models, and the

determination of mineral specimens by physical characteristics, and by the blow-pipe. The student is expected to become familiar with about one hundred and fifty mineral species.

GEOLOGY.—The study of Geology will be pursued during the second term of the third year. A large collection of geological specimens, including minerals, fossils and rocks, has been added to illustrate the department. The course of lectures includes Structural Geology, Paleontology, and Economic Geology, illustrating as far as practicable the occurrence of ore deposits and other economic products

Physics.

The instruction in Physics commences with the second year. Students who take the course in Physics, as well as those taking such portions of the course as are assigned by the instructors in their special department, are thus enabled to have the benefit of a year's general training, and in particular they will be sufficiently advanced in Mathematics to make their progress in the theoretical portions of the subject less difficult and more rapid.

The instruction is given mainly by a course of lectures, and, wherever possible, the principles involved, as well as their applications, are illustrated by experiments. The lectures are supplemented by questions and problems which test the thoroughness of the student's knowledge, and give ample opportunity for the further elucidation of such points as are imperfectly understood.

In order that the principles involved may be realized as actual truths, the students are required to spend a considerable portion of their time in the Physical Laboratory, in which instruction will be given in the use of instruments of precision, in physical manipulation, in the actual testing of the laws and principles given in the course of lectures, including experiments and measurements in Mechanics, Acoustics, Heat, Light, Electricity, and Magnetism.

The laboratory will be generously provided with the best and most modern instruments and appliances, to all of which the students have free access. A workshop, adjoining the laboratory, affords opportunity for constructing and arranging apparatus, and

the student is encouraged in devising and executing with his own hands any apparatus he may require for special work.

Practical problems are assigned in

MECHANICS: involving comparisons of standards of length, accurate measurements of strength of materials, laws of extension, flexure and torsion, determinations of density, laws of fluid pressure, etc.

ACOUSTICS: determinations of pitch and composition of sounds, lengths of sound-waves, and velocity of sound.

HEAT: determinations of specific and latent heat, calibration and testing of thermometers, and measurements of co-efficient of expansion.

LIGHT: measurements of intensity of light by the photometer, laws of reflection, refraction, dispersion and polarization of light; constants of optical instruments, spectrum analysis, saccharimetry and measurement of wave lengths; photography.

ELECTRICITY AND MAGNETISM.—Examples of practical problems assigned are: management of batteries, measurement of currents, resistances and electromotive forces, constants of galvanometers, electrometers, and dynamometers.

Students who take the course in Physics will continue their laboratory work during the second, third and fourth years. During the fourth year, they will be expected to undertake an original research, which is to form the subject of a thesis. They will also be expected to prepare and deliver one or more illustrated lectures on any branch of Physics they may select.

Chemistry.

GENERAL CHEMISTRY: a course of experimental lectures, with recitations on general and descriptive chemistry, is attended throughout the first year by all regular students. These lectures are accompanied by an extended course of laboratory practice, which includes manipulation of apparatus, quantitative experiments illustrating the principles of stoichiometry, a study of the laws of chemical action, and the preparation and properties of the more important elements and their compounds. This course

is intended to give a sufficiently comprehensive knowledge of chemistry to meet the wants of all students who do not propose to make a special study of this subject.

ANALYTICAL CHEMISTRY: the first term of the second year is devoted to systematic qualitative analysis in the laboratory, with lectures and recitations on the principles of chemical philosophy. Quantitative analysis is begun with the second term, and it includes simple determinations and separations, which are followed in the third and fourth years by analysis of minerals, ores, slags and commercial products.

ORGANIC CHEMISTRY: a course of lectures on the principles of organic chemistry extends through the third year, with laboratory work on organic analysis, vapor density determinations, fractional distillation, and the preparation and study of organic products.

CHEMICAL TECHNOLOGY: during the first term of the fourth year, chemical technology and the methods of industrial chemistry are taught by recitations and laboratory work. Excursions are taken, so far as practicable, to manufacturing establishments, for the inspection of some of these methods in actual operation. For the study of certain technical processes, especially those relating to the technology of petroleum and of iron and steel, Cleveland offers exceptional facilities.

The course in Chemistry, as above arranged, is intended for students who desire to prepare themselves for professional work, or to become teachers. That portion of the course included in the second term of the third year and the fourth year, is flexible, and, with certain limitations, the student is permitted to devote especial attention to branches of the subject adapted to his individual taste or ability. Persons who desire a general scientific training may take, in connection with other subjects, any portion of the course which they are qualified to pursue.

The Chemical Laboratory contains the necessary appliances for practical work in inorganic and organic chemistry. Besides the boiler room, the basement contains a room for laboratory preparation work and for the storage of certain chemicals, and a larger room, 30x25 feet, which is used for furnace work, distillations,

and the preparation of chemical products. The first story contains the quantitative laboratory, a private laboratory, the balance and reading room, and a private office. On the second story are arranged the lecture room, the elementary laboratory, and a photographic room. The upper floor serves for storage of chemicals and apparatus.

The Chemical Club, which is composed of the students and instructors, meets weekly for reviews of current literature, and for discussions of special subjects. It is supplied with all the principal chemical periodicals.

Architecture.

Students in Architecture will find a large part of the Civil Engineering course suited to their needs. Those preparing to enter an architect's office will find the mathematics, drawing, stereotomy, strength of materials, stability of structures, and lectures on architectural styles, especially adapted to their requirements.



LIBRARY OF CONGRESS



0 030 003 124 9